

MA104 - Differential Calculus
Homework Assignment 3 - 35 points
Due by 1600 on Thursday, March 13, 2008

Be sure to show all work to ensure full credit!

1. (2 points each) Use Mathematica to plot the following parametric equations. On your plot, note the starting point of the curve and indicate with an arrow the direction in which the curve is traced as t increases.

(a) $x = 1 + t, y = 5 - 2t, -2 \leq t \leq 3$

(b) $x = 2 \cos(t), y = t - \cos(t), 0 \leq t \leq 2\pi$

2. (9 points) Suppose the path of a stinger missile (sm) is traced by the set of parametric equations

$$\langle x_{sm}(t), y_{sm}(t), z_{sm}(t) \rangle = \langle 12t, t^4 + 8t, t \rangle$$

and the path of an enemy aircraft (ea) is traced by a set of parametric equations

$$\langle x_{ea}(t), y_{ea}(t), z_{ea}(t) \rangle = \langle t^3 + 8t, t^5, 2 \rangle,$$

where t is time in seconds. Does the stinger impact the enemy aircraft? If so, how long after firing the missile does the impact occur?

3. (3 pts each) For the following sets of vectors find: $|\mathbf{a}|, \mathbf{a} + \mathbf{b}, \mathbf{a} - \mathbf{b}, 2\mathbf{a}, 3\mathbf{a} + 4\mathbf{b}$

(a) $\mathbf{a} = \langle -3, -4, -1 \rangle$ and $\mathbf{b} = \langle -6, 2, -3 \rangle$

(b) $\mathbf{a} = 2\mathbf{i} - 4\mathbf{j} + 3\mathbf{k}$ and $\mathbf{b} = 33\mathbf{j} + 4\mathbf{k}$

4. (3 pts) Find a vector that has the same direction as the vector $\langle 2, 3, -1 \rangle$ but has length 10.

5. (6 pts) Let $\mathbf{a} = \langle 4, -1, 2 \rangle$ and $\mathbf{b} = \langle -2, 6, 2 \rangle$. Answer the following:

(a) Compute $\mathbf{a} \cdot \mathbf{b}$ by hand.

(b) Compute $\mathbf{a} \times \mathbf{b}$.

(c) Compute the angle between the two vectors \mathbf{a} and \mathbf{b} .

(d) Are \mathbf{a} and \mathbf{b} orthogonal? Why or why not?

(e) Compute the vector projection of \mathbf{b} onto \mathbf{a} .

(f) Find a unit vector that is orthogonal to both \mathbf{a} and \mathbf{b} .

6. (3 pts) Find the parametric equations for the line segment that joins $P(-2, 4, 0)$ and $Q(6, -1, 2)$.

7. (4 pts) Find parametric equations for the tangent line to the curve with the following parametric equations

$$x = \cos(t), y = 3e^{2t}, z = 3e^{-2t}$$

at the specific point $(1, 3, 3)$. (Hint: What is t at this point?) Illustrate by graphing both the curve and the tangent line on a common graph. Attach graph to assignment.